Table 1. Nozzle 1 NDE Examination Results

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer:	FENOC	**Plant:**	Davis Besse	**Unit:**	n/a	**Nozzle:**	1
Procedure:	54-ISI-100-08 CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**		**ID:** 2.765	**OD:** 4.06	**Thickness:**	0.649
Downhill Side of Nozzle (deg.):	183	**End of Noz. (in.)**	29.6	Probe Serial No.'s:	Ch 1 2078-01002-0L	Ch 6	21GB-01002-45L
Axial Scan	Start: -6, 15.06	Stop: 360, 29.63	**Setup:** 1		Ch 2 21GF-01004-30L	Ch 7	21GC-01001-55L
Files:	T2061_12.36.51				Ch 3 21GA-01004-45L	Ch 8	22CD-01001-65L
Circ. Scan	Start: -5, 19.23	Stop: 360, 29.63	**Setup:** 2		Ch 4 2623-01002-60S	Ch 9	2624-01005-60S
Files:	T2061_11.11.08				Ch 5 2623-01002-60S	Ch 10	2624-01005-60S

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD	0.29	26.97	133	28.31	128	1.34	50.0	55.0	0.18	1.35	8	0.36	0.27	AXIAL	In Weld Region	
2	OD	0.24	26.63	115	28.29	113	1.66	68.0	70.0	0.07	1.66	2	0.41	0.24	AXIAL	In Weld Region	
3	OD	0.63	27.71	51	28.11	53	0.40	132.0	130.0	0.07	0.41	10	0.02	0.05	AXIAL	In Weld Region	
4	OD	TW	26.9	31	28.67	29	1.77	152.0	154.0	0.07	1.77	2	0.65	0.37	AXIAL	In Weld Region	
5																	
6	OD	0.04	27.1	334	28.8	334	1.70	209.0	209.0	0.00	1.70	0	0.61	0.36	AXIAL	In Weld Region	
7	OD	TW	25.95	285	29.43	291	3.48	258.0	252.0	0.21	3.49	3	0.65	0.19	AXIAL	In Weld Region	
8	OD	0.32	27.58	233	28.45	233	0.87	310.0	310.0	0.00	0.87	0	0.33	0.38	AXIAL	In Weld Region	
9	OD	0.28	27.6	202	28.35	202	0.75	341.0	341.0	0.00	0.75	0	0.37	0.49	AXIAL	In Weld Region	
10	OD	0.24	27.64	181	28.86	181	1.22	2.0	2.0	0.00	1.22	0	0.41	0.34	AXIAL	In Weld Region	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

WELD PROFILE															
	Data Loc.	183	213	243	273	303	333	3	33	63	93	123	153	183	Degrees
	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	29.60	Inches
	MAX.	27.85	27.82	27.89	27.89	27.89	27.89	27.97	27.97	27.93	27.85	27.89	27.82	27.85	Inches
	MIN.	26.55	26.55	26.67	26.71	26.59	26.40	26.40	26.40	26.44	26.59	26.59	26.59	26.55	Inches

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: Data was encoded with positive Theta going counterclockwise. Adjusted circ. positions have corrected the position to read clockwise looking down.

Flaw # 5 was identified as an axial flaw using the circ. blade probe but is not confirmed with the rotating UT. Therefore, flaw #5 is not relevant.

Analyzed by: K.C.Gebetsberger **Date:** 3/5/02 **Analyzed by:** M.G. Hacker **Date:** 3/5/02

Table 2. Nozzle 2 NDE Examination Results

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer:	FENOC	**Plant:**	Davis Besse	**Unit:**	N/A	**Nozzle:**	2
Procedure:	54-ISI-100-08 CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**	**ID:** 2.765	**OD:** 4.06		**Thickness:**	0.649
Downhill Side of Nozzle (deg.):	315	**End of Noz. (in.)**	30.78	Probe Serial No.'s:	Ch 1 2078-01002-0L		Ch 6 21GB-01002-45L
Axial Scan	Start: -5, 16.1	Stop: 360, 30.77	**Setup:** 1		Ch 2 21GF-01004-30L		Ch 7 21GC-01001-55L
Files:	T2061_09.12.19				Ch 3 21GA-01004-45L		Ch 8 22CD-01001-65L
Circ. Scan	Start: 0, 18.95	Stop: 360, 29.52	**Setup:** 2		Ch 4 2623-01002-60S		Ch 9 2624-01005-60S
Files:	T2061_07.25.10				Ch 5 2623-01002-60S		Ch 10 2624-01005-60S

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD	0.236	27.46	291.0	29.51	275.0	2.05	24.0	40.0	-0.57	2.13	165	0.41	0.19	AXIAL	In Weld Region	
2	OD	TW	26.59	262.0	30.37	240.0	3.78	53.0	75.0	-0.78	3.86	168	0.65	0.17	AXIAL	In Weld Region	
3																	
4	OD	TW	26.69	148.0	29.39	141.0	2.70	167.0	174.0	-0.25	2.71	175	0.65	0.24	AXIAL	In Weld Region	
5	OD	0.33	27.87	130.0	28.7	127.0	0.83	185.0	188.0	-0.11	0.84	173	0.32	0.38	AXIAL	In Weld Region	
6	OD	TW	26.8	67	29.36	78	2.56	248.0	237.0	0.39	2.59	9	0.65	0.25	AXIAL	In Weld Region	
7																	
8	OD	TW	26.35	32	30.16	61	3.81	283.0	254.0	1.03	3.95	15	0.65	0.16	AXIAL	In Weld Region	
9																	
10	OD	TW	27.39	7	30.35	26	2.96	308.0	289.0	0.67	3.04	13	0.65	0.21	AXIAL	In Weld Region	
11	OD	0.344	27.9	314	27.75	347	0.15	361.0	328.0	1.17	1.18	83	0.31	0.26	CIRC.	0.1	0.1
12	OD	0.572	29.02	320	29.6	327	0.58	5.0	12.0	0.25	0.63	23	0.08	0.12	AXIAL	In Weld Region	
13																	
14																	
15																	
16																	
17																	

Revision 1 3/11/02

WELD PROFILE														
Data Loc.	315	345	15	45	75	105	135	165	195	225	255	285	315	Degrees
Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
Noz. End	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	30.78	Inches
MAX.	29.17	29.09	29.02	28.84	28.61	28.49	28.46	28.49	28.76	28.92	29.04	29.14	29.17	Inches
MIN.	28.06	27.79	27.36	27.39	27.31	27.16	27.16	27.24	27.36	27.39	27.84	27.89	28.06	Inches

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: Data was encoded with positive Theta going counterclockwise. Adjusted circ. positions have corrected the position to read clockwise looking down.

Flaws #3, 7,and 9 were identified as axial flaws using the circ. blade probe but are not confirmed with the rotating UT. Therefore, flaws #3, 7, and 9 are not relevant.

Analyzed by: K.C.Gebetsberger **Date:** 3/5/02 **Analyzed by:** M.G. Hacker **Date:** 3/5/02

Table 3. Nozzle 3 NDE Examination Results

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC		**Plant:** Davis Besse		**Unit:** n/a		**Nozzle:** 3
Procedure: 54-ISI-100-08	CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**	**ID:** 2.765	**OD:** 4.06		**Thickness:** 0.649
Downhill Side of Nozzle (deg.): 150		**End of Noz. (in.** 30.75	Probe Serial No.'s:	Ch 1 2078-01002-0L		Ch 6 21GB-01002-45L
Axial Scan Start: -5, 16	Stop: 360, 30.81	**Setup:** 1		Ch 2 21GF-01004-30L		Ch 7 21GC-01001-55L
Files: T2061_15.39.37				Ch 3 21GA-01004-45L		Ch 8 22CD-01001-65L
Circ. Scan Start: 6, 20.3	Stop: 360, 30.88	**Setup:** 2		Ch 4 2623-01002-60S		Ch 9 2624-01005-60S
Files: T2061_14.09.39				Ch 5 2623-01002-60S		Ch 10 2624-01005-60S

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD	TW	26.6	151.0	30.68	156.0	4.08	1.0	6.0	0.18	4.08	2	0.65	0.16	AXIAL	In Weld Region	
2																	
3	OD	0.234	28.07	275.0	29.19	280.0	1.12	125.0	130.0	0.18	1.13	9	0.42	0.37	AXIAL	In Weld Region	
4	OD	TW	26.07	319.0	29.89	330.0	3.82	169.0	180.0	0.39	3.84	6	0.65	0.17	AXIAL	In Weld Region	
5	OD	0.212	28.4	136.0	29.46	143.0	1.06	346.0	353.0	0.25	1.09	13	0.44	0.40	AXIAL	In Weld Region	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

WELD PROFILE	Data Loc.	150	180	210	240	270	300	330	360	30	60	90	120	150	Degrees
	Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
	Noz. End	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	Inches
	MAX.	29.08	29.08	29.02	28.70	28.54	28.38	28.35	28.41	28.63	28.80	28.96	29.02	29.08	Inches
	MIN.	27.83	27.77	27.51	27.23	27.07	26.94	26.95	27.00	27.19	27.42	27.67	27.80	27.83	Inches

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: These are axial flaws that extend from below the weld region into the weld region. They were also detected with the circ. blade probe.

Flaw # 2 was identified as an axial flaw using the circ. blade probe but is not confirmed with the rotating UT. Therefore, flaw #2 is not relevant.

Analyzed by: K.C. Gebetsberger **Date:** 3/5/02 **Analyzed by:** M.G. Hacker **Date:** 3/5/02

Table 4. Nozzle 5 NDE Examination Results

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer:	FENOC	**Plant:**	Davis Besse	**Unit:**	N/A	**Nozzle:**	5
Procedure:	54-ISI-100-08 CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**		**ID:** 2.765	**OD:** 4.06	**Thickness:**	0.649
Downhill Side of Nozzle (deg.):	320	**End of Noz. (in.**	30.75	Probe Serial No.'s:	Ch 1 2078-01002-0L	Ch 6	21GB-01002-45L
Axial Scan	Start: -4, 16.11	Stop: 360, 30.78	**Setup:** 1		Ch 2 21GF-01004-30L	Ch 7	21GC-01001-55L
Files:	T2061_18.30.12				Ch 3 21GA-01004-45L	Ch 8	22CD-01001-65L
Circ. Scan	Start: -6, 19	Stop: 360, 29.41	**Setup:** 2		Ch 4 2623-01002-60S	Ch 9	2624-01005-60S
Files:	T2061_16.53.38				Ch 5 2623-01002-60S	Ch 10	2624-01005-60S

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1	OD	0.2	28.44	274.0	29.69	271.0	1.25	274.0	271.0	-0.11	1.25	5	0.45	0.36	AXIAL	In Weld Region	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

WELD PROFILE														
Data Loc.	320	350	20	50	80	110	140	170	200	230	260	290	320	Degrees
Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
Noz. End	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	Inches
MAX.	29.10	29.07	29.07	28.91	28.73	28.60	28.52	28.40	28.46	28.67	28.91	28.96	29.10	Inches
MIN.	27.90	27.89	27.89	27.68	27.39	27.21	27.13	27.10	27.10	27.21	27.68	27.91	27.90	Inches

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: This is an axial flaw that extends into the weld region. This flaw was also detected sing the circ. blade probe.

Analyzed by: K. C. Gebetsberger **Date:** 3/5/02 **Analyzed by:** M.G.Hacker **Date:** 3/5/02

Table 5. Nozzle 47 NDE Examination Results

FRAMATOME ANP

CRDM Nozzle Ultrasonic Examination Data Sheet

Customer: FENOC		**Plant:** Davis Besse		**Unit:** N/A		**Nozzle:** 47	
Procedure: 54-ISI-100-08	CA: FRA-02-002, DB-02-012	**Nozzle Dimensions: (in.)**		**ID:** 2.765	**OD:** 4.06	**Thickness:** 0.649	
Downhill Side of Nozzle (deg.): 143	**End of Noz. (in.** 45.9	Probe Serial No.'s:		Ch 1	2078-01002-0L	Ch 6	21GB-01002-45L
Axial Scan Start: -6, 29.9	Stop: 360, 45.9	**Setup:** 1		Ch 2	21GF-01004-30L	Ch 7	21GC-01001-55L
Files: T2062_01.40.41				Ch 3	21GA-01004-45L	Ch 8	22CD-01001-65L
Circ. Scan Start: -6, 34	Stop: 360, 46	**Setup:** 2		Ch 4	2623-01002-60S	Ch 9	2624-01005-60S
Files: T2062_23.53.48				Ch 5	2623-01002-60S	Ch 10	2624-01005-60S

Flaw No.	Surface (ID/OD)	Depth to Flaw Tip	End Point 1 Min (in.)	End Point 1 Min (deg.)	End Point 2 Max (in.)	End Point 2 Max (deg.)	Axial Total (in.)	Adjusted Circ. Extent Min (deg.)	Adjusted Circ. Extent Max (deg.)	Adjusted Circ. Extent Total (in.)	Flaw Length (in.)	Flaw Angle (deg.)	Flaw TWD (in.)	Flaw Aspect Ratio	Flaw Orientation	Weld Location @ Flaw Min	Weld Location @ Flaw Max
1																	
2																	
3	OD	0.06	43.23	181.0	45	202.0	1.77	38.0	59.0	0.74	1.92	23	0.59	0.31	AXIAL	In Weld Region	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	

WELD PROFILE														
Data Loc.	143	173	203	233	263	293	323	353	23	53	83	113	143	Degrees
Noz. Loc.	0	30	60	90	120	150	180	210	240	270	300	330	360	Degrees
Noz. End	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	Inches
MAX.	44.48	44.58	44.10	43.40	42.67	42.10	41.75	41.94	42.58	43.31	44.01	44.42	44.48	Inches
MIN.	43.10	42.96	42.42	41.49	40.54	39.62	39.39	39.49	40.19	41.40	42.38	42.96	43.10	Inches

Notes: Adjusted Circ. Extent is relative to downhill side of nozzle;clockwise looking down. TWD is Through-Wall Dimension

Comments: Flaw #3 is an axial flaw that extends into the weld region. This flaw was also detected with the circ. blade probe.

Flaws #1 and #2 were identified with the circ. blade probe but were determined not to be valid detections with the rotating UT. Nozzle ovality in the location of these indications is the source of these false indications. Flaw #4 was detected with the rotating UT but it is located in the J-groove weld fillet and outside the nozzle wall and is therefore outside the scope of this procedure.

Analyzed by: K. C. Gebetsberger **Date:** 3/4/02 **Analyzed by:** M. G. Hacker **Date:** 3/4/02

Table 6. Comparison of Davis-Besse to Other B&W Design Plants

Parameter	Oconee 1	Oconee 2	Oconee 3	ANO-1	Davis-Besse	TMI-1	Crystal River 3
NSSS*	B&W	B&W	B&W	B&W	B&W	B&W	B&W
Material Supplier*	BWTP	BWTP	BWTP	BWTP	BWTP	BWTP	BWTP
Head Fabricator*	B&W	B&W	B&W	B&W	B&W	B&W	B&W
Design Nozzle Fit (mils)*	0.5 – 1.5	0.5 – 1.5	0.5 – 1.5	0.5 – 1.5	0.5 – 1.5	0.5 – 1.5	0.5 – 1.5
EFPYs Through Feb 2001*	20.4	20.3	20.1	8.0	14.7	16.8	14.9
Head Temp (°F)*	602	602	602	602	605	601	601
EFPYs Normalized to 600°F*	22.1	22.0	21.7	19.5	17.9	17.5	15.6
EFPYs to Reach Oconee 3*	-0.3	-0.2	0.0	2.1	3.1	4.1	5.9
Access Ports in Lower Shroud	Yes	Yes	Yes	No	No	Yes	Yes
Number of CRDM Nozzles	69	69	69	69	69	69	69
- With Leaks	1	4	14	1	3	5	1
- Leaks & Circ Cracks	0	1	4	0	1	0	1
- With Heat M3935	0	0	68	1	5	0	0
Number of T/C Nozzles	8	0	0	0	0	8	0
- With Leaks	5 confirmed	N/A	N/A	N/A	N/A	8	N/A
Counterbore at Bottom of CRDM Nozzles	Yes	Yes	Yes	Yes	No	Yes	Yes
As-Built Fit Range for Leaking Nozzles (mils)	Clearance	Clearance to 1.4 Interference	Clearance to 1.0 Interference	0.4 – 0.7	0.1 – 2.0		
Wastage at Leaks	No	No	No	No	Yes	No	No

* Data from MRP-48, PWR Materials Reliability Program – Response to NRC Bulletin 2001-01 (EFPY data as of February 2001).

Table 7. Nuclear Industry Experience Review Results

NRC Documents

Document	**Davis-Besse Response/Actions**	**Comments**
Bulletin 82-2, Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants. • Implement maintenance procedures for threaded fasteners. • Inspect and clean fasteners when removed. • List RCS closures that have leaked. • List where thread lubricants and Furminite was used on RCS fasteners.	• Maintenance procedures for threaded fasteners were written. • Inspection and cleaning of fasteners was added to the maintenance procedure. • Ten CRDM flanges and OTSG lower primary hand holes have leaked. • CRD reactor vessel nozzle bolts and OTSG manway & hold down bolts are lubricated. • One of the RCS cold leg thermowells was Furminited.	In 1987, an NRC inspection of the Bulletin concluded there were no violations or deviations.
GL 88-5, Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants. The document requested assurances that Davis-Besse have a program to ensure that boric acid corrosion does not lead to degradation of the RCS boundary. The program should include: • Listing where small leaks could cause degradation, • Procedures for finding small leaks, • Evaluating the impact of leaks, & • Preventive actions for corrosion.	The Davis-Besse program consists of several programs and procedures. • Leakage Management Program, which identifies and the location of the leakage and evaluates the boric acid concern. • Shutdown procedure, which requires a walkdown of containment valves and a general containment walkdown. • ASME Section XI Inservice Pressure Test, which performs a visual inspection to look for discoloration. If boric acid residue is identified, find the source, determine the extent, and repair. • CRD Flanges are inspected each refueling. Gaskets are replaced on leaking joints. This will be incorporated into the PM program.	Although CRDM flanges are inspected, CRDM nozzles are not specifically listed. During an audit of the boric acid corrosion prevention program, the NRC found the program met the intent of the Generic Letter. Implementing procedures still need to be made effective. Engineers should be trained. Inspections should be documented.

Document	Davis-Besse Response/Actions	Comments
	• Periodic fastener inspection as a result of the IE Bulletin 82-2, Degradation of Threaded Fasteners in the RC Pressure Boundary of PWRs. • Limited Thermographic Inspections in containment to detect steam leaks as part of the current outage. • Live Load Packing of Valves to reduce stem leakage may be used if it proves a viable method. Davis-Besse will implement a Boric Acid Corrosion Program to include all the requirements of GL 88-5 in 1989.	
IN 80-27, Degradation of Reactor Coolant Pump Studs. Several reactor coolant pump studs incurred boric acid wastage as a result of leaks in the pump flanges. If undetected, corrosion of RCP studs could cause the loss of the RCS pressure boundary. To detect, supplemental visual examinations and instrumented leak detection are needed. Undetected wastage could occur in other components.	An inspection of the Davis-Besse studs in 1980 revealed no corrosion in the studs for 3 of 4 RCPs. A small amount of rust and boric acid around the studs for 1 RCP was from an overhead valve leak, which was fixed previously. A work order was issued to clean the area. There is a drain between the inner and outer gaskets which goes to the containment sump, but there is no monitoring of the leakage and the drain valve is normally closed.	Also described in SOER 81-12 and SER 46-80.
IN 82-6, Failure of Steam Generator Primary Side Manway Closure Studs. There have been a significant number of failed or degraded bolts and studs due to stress corrosion cracking and corrosion wastage that are difficult to detect.	Response was deferred to the response to NRC Bulletin 82-2 Degradation of Threaded Fasteners in the RC Pressure Boundary of PWR plants.	

Document	Davis-Besse Response/Actions	Comments
IN 86-108, Degradation of RCS Pressure Boundary Resulting From Boric Acid Corrosion. Boric acid from a leaking valve caused wastage of a carbon steel HPI line. The primary defense is to minimize leaks, detect and stop leaks soon after they start, and promptly clean up any boric acid residue. Detection of leaks will be enhanced by an evaluation of any iron oxide stains on insulation.	The Davis-Besse HPI line geometry is different. Provisions regarding iron oxide stains on RCS piping insulation will be included in the ASME Section XI Inservice Pressure Tests procedure.	The response is limited and fails to recognize the larger issue of boric acid corrosion.
IN 86-108 Supplements 1 & 2, Degradation of RCS Pressure Boundary Resulting From Boric Acid Corrosion. Supplement 1: Boric acid corrosion/wastage on the head of the Turkey Point 4 reactor and boric acid crystals in the CRDM cooling ducts. Small RCS leaks can concentrate the boric acid and rapidly corrode carbon steel. Supplement 2: Boric acid corrosion/wastage on the head of the Salem 2 reactor and failure of a shutdown cooling valve bolts due to boric acid corrosion. The INs recommended that inspection programs be reviewed to ensure adequate monitoring.	During shutdowns, a mode 3 containment walkdown will look for any buildup of boron on piping or valves and to notify engineering of any of any potential problem areas. An RCS leakage management policy maintains RCS leakage as low as possible and identifies and evaluates corrosion concerns.	The mode 3 walkdowns cannot inspect the reactor head.
IN 90-10, Primary Water Stress Corrosion Cracking (PWSCC) of Inconel 600. Plants should review their Inconel 600 applications and implement an augmented inspection program.	BWOG studied the problem in B&W Document 51-1201160-00. We expected the BWOG to recommend additional inspections. The study demonstrates that the issue of Inconel 600 applications is adequately reviewed and inspections are being formulated. Therefore, the intent of the IN is	This was evaluated along with SER 2-90 by RFA 90-831. However, the NRC made the issue much broader than INPO. We deferred our evaluation to the BWOG, which is summarized in the "Other Documents" below.

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	met.	
IN 86-108 Supplement 3, Degradation of RCS Pressure Boundary Resulting From Boric Acid Corrosion. Issued in 1995. Corrosion problems at Calvert Cliffs and TMI had earlier indication of leakage and in both cases, boric acid leakage was not immediately cleaned and stopped. The primary defense is minimize leakage, detect and stop leaks, & promptly clean the residue.	The Boric Acid Corrosion Control program addresses the issue.	The response just make the statement that the Boric Acid Corrosion Control program covers the concern but provides no basis for the conclusion.
IN 94-63, Boric Acid Corrosion of Charging Pump Casing Caused by Cladding Cracks. Although boric acid wastage occurs slowly, an attack can eventually lead to significant thinning of carbon steel cladding and possibly leakage. Corrosion of the base metal is easy to find though visual inspection.	This is not applicable to Davis-Besse since the Make-up Pumps and HPI pumps are solid stainless steel.	The Davis-Besse evaluation was narrowly focused on the charging pump and not on boric acid corrosion in general.
IN 96-11, Ingress of Demineralizer Resins Increases Potential for Stress Corrosion Cracking of Control Rod Drive Mechanism Penetrations. EPRI is researching ways to mitigate PWSCC and developed a demonstration program to ensure that inspections performed on CRDM penetrations are highly reliable in detecting and determining the size of flaws. Resin intrusion into the RCS will cause circumferential Intergranular Stress Corrosion Cracking. There is a high probability that CRDM penetrations contain cracks caused by PWSCC.	The response deals with intrusion of demineralizer resins in the RCS. Davis-Besse has had no resin intrusion. PWSCC probability is low because of water chemistry and actions would be taken on high sulfate levels.	The Davis-Besse evaluation was narrowly focused on the resin intrusion and did not address PWSCC.

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Generic Letter 97-1, Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations. An integrated, long-term program, which includes periodic inspections and monitoring, is necessary. The following is requested: • Results of CRDM nozzle inspections. • Schedule for subsequent CRDM nozzle inspections. • The scope of subsequent inspections. • Or justify why no inspection is needed. • A description of resin bed intrusions.	The response is in B&WOG Topical Report, "B&WOG Integrated Response to Generic Letter 97-01: Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations," BAW -2301. Inspections for B&W plants will be preformed based on susceptibility. There have been no resin bed intrusions at B&W plants. NEI proposed an integrated inspection program based on susceptibility.	Responses to requests for additional information were answered by NEI for the industry. The response emphasized that the integrated program is an ongoing program that will be implemented in conjunction with EPRI, the PWR Owners Groups, the participating utilities, and the Material Reliability Project's Subcommittee on Alloy 600.
IN 2000-17, Crack in Weld Area of Reactor Coolant System Hot Leg Piping at V.C. Summer. A crack was found on a weld on a hot leg pipe. Elevated leakage and radiation was not seen. It was found by discovering boric acid. When the root cause is determined, a supplement will be issued.	This is preliminary information and no action can be taken at this time. The information was adequately distributed for current needs. This information will be added to the final OE evaluation.	Although the IN only contained information and gave no recommendation on what could be done, it may have been more appropriate to have the system experts make that call. See the V.C. Summer Root Cause in the "Other Documents" section.
IN 2000-17 Supplement 1, Crack in Weld Area of Reactor Coolant System Hot Leg Piping at V.C. Summer. A multi-disciplined team will conduct a root cause. A foreign plant also had crack indications in the hot leg. When the root cause is determined, another supplement will be issued.	This is preliminary information and no action can be taken at this time. The information was adequately distributed for current needs. This information will be added to the final OE evaluation.	Although the IN only contained information and gave no recommendation on what could be done, it may have been more appropriate to have the system experts make that call. See the V.C. Summer Root Cause in the "Other Documents" section.
IN 2000-17 Supplement 2, Crack in Weld Area of Reactor Coolant System Hot Leg Piping at V.C. Summer. The crack was	The issue is still under evaluation and we expect further information to be released by the NRC. The only action needed at this time	The OE program incorrectly assumed that more information would be issued. However, the V.C. Summer Root Cause Evaluation was

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caused by PWSCC. Extensive weld repairs were a contributing cause. The V.C. Summer root cause was thorough and concluded it was PWSCC. Welding met code requirements. Leak detection enhancements will be made. The following generic issues need to be addressed. • NDE failed to detect the cracks. • ASME code allows multiple weld repairs. • Weaknesses in leak detection systems. • Applicability of "Leak before break" analysis.	is information distribution. When the final document is evaluated, this information will be attached.	complete. Yet it wasn't obvious to the review committee that this supplement listed the generic causes. It may have been more appropriate to have the system experts review the information. There are several references to additional problems, but there was no effort to seek out the additional information. See the V.C. Summer Root Cause in the "Other Documents" section.
IN 2001-5, Through-Wall Circumferential Cracking of Reactor Pressure Vessel Head Control Rod Drive Mechanism Penetration Nozzles at Oconee Nuclear Station, Unit 3.	Response was deferred to the response to NRC Bulletin 2001-1.	The response to the Information Notice failed to follow the OE program. See CR 2001-2997.

INPO SEE-IN Documents

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SOER 81-12, Reactor Coolant Pump Closure Stud Corrosion. The SOER noted that insulation reduces the likelihood of discovering leakage/boric acid deposits and the insulation may have caused retention of borated water and increased the possibility of corrosion. The SOER noted that the rate of corrosion increased when boric acid deposits are wetted and present inspection frequencies	The DB response said that the RCP studs were inspected in 1980 and no damage was found. Boric acid was found and cleaned. We have a procedure and PM to inspect the studs. Both perform a visual examination and generate a Material Deficiency if anything relevant is found.	This SOER was last reviewed in March 2001. The SOER and evaluation is very focused on RCP studs. However, it brings out the facts that boric acid corrosion can be rapid and insulation needs to be removed to find boric acid deposits. Also described in IN 80-27 and SER 46-80.

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are not adequate for timely detection. Recommended a visual inspection of the RCP closure studs. Recommended removal of residual leakage and boron deposits from the closure flange area.	The response says that if boric acid deposits are found, areas will be inspected & deposits removed according to NG-EN-324.	
SOER 84-5, Bolt Degradation or Failure in Nuclear Power Plants. The SOER noted that fastener failures are occurring due to boric acid corrosion and stress corrosion cracking. The SOER recommended that we ensure prompt repair of leaking joints with boric acid deposits.	Practices are in place to identify and fix leaks. We perform walkdowns in containment to find and fix leaks (if possible) to minimize boric acid damage. Work requests for boric acid leaks receive higher priority due to radiation and contamination corrosion concerns.	A Green SOER that is no on the INPO 97-10 list. This SOER was last reviewed in late 1987. The response many times cited routine inspections or walkdowns that we perform, but those can't identify leaks in containment. The response still didn't seem to recognize the importance of boric acid corrosion. The response says boric acid leaks are repaired because of radiation and contamination concerns, not because of corrosion concerns. Based on the lack of action to fix RC2, we did not promptly repair the leaking joint with boric acid deposits.
SER 46-80, Reactor Coolant Pump Closure Stud Corrosion. The SER noted that leaking gasketed joints (e.g., Control rod drives & reactor vessel head) might be affected by boric acid attack. Although closure studs are subject to inservice inspections, corrosion damage was not detected.	No specific DB response was found.	This issue was subsequently described in SOER 81-12. Also described in IN 80-27.
SER 35-81, Corrosion of Reactor Coolant System Piping. The SER says corrosive	No DB response was found.	

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attack could reduce primary boundary integrity. INPO will continue to evaluate this event.		
SER 11-82, Reactor Coolant Pump Closure Flange Stud Corrosion. The repeat of stud corrosion and the amount of corrosion re-inforces the importance of frequent visual inspections and removal of boric acid deposits - as described in SOER 81-12.	No DB response was found.	
SER 57-83, Cracking in Stagnant Boric Acid Piping. Many cracking incidents have occurred.	Seven line handwritten response saying boric acid piping is inspected in the ISI program and this hasn't happened here. The SER was distributed for information.	
SER 72-83, Damage to Carbon Steel Bolts and Studs on Valves in Small Diameter Piping Caused by Leakage of Borated Water. When scheduling maintenance, take boric acid corrosion rates into account. Ten year ISI may not be frequent enough.	The evaluation was deferred to SOER 84-5. The SER was distributed for information.	In previous responses, we've claimed that boric acid piping is inspected during by the ISI program, yet this has warned us that the ISI is not adequate to detect these problems.
SER 32-84, Contamination of Reactor Coolant System by Magnetite and Sulfates.	No DB response was found.	Although this discusses RCS leakage, this doesn't appear to provide any insight to this issue.
SER 41-85, Containment Spraying Events. Prompt clean up of boric acid reduces corrosion. Boric Acid solutions in insulation are hard to remove.	DB recognizes that prompt clean up is essential to ensuring the integrity of carbon steel. The ability to detect and clean up each boric acid spill will depend on the circumstances. An Erosion/corrosion program will find degradation.	The evaluation failed to address the problems with insulation. The erosion/corrosion program response has no bearing on the concern.
SER 13-87, Reactor Vessel Stud Corrosion	We inspect reactor head area by operations	The body of the SER was focused on

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from Primary Coolant Leak. Inspect reactor head for boron during all planned and unplanned outages. The 1 GPM T.S. won't detect small leaks.	walkdown during shutdowns. During startups, we inspect containment.	fasteners and said that no structural integrity was effected. This may have influenced the evaluators against concerns about what is happening in the service structure. Operations walkdowns would not be able to detect boric acid on the head. At best, this evaluation may have assumed that operations could see any boric acid draining down onto the reactor head studs. The evaluation failed to understand that a detailed internal inspection was needed. During the times cited in the evaluation, this could not have been done.
SER 31-87, Pressurizer Vessel Corrosion due to Pressurizer Heater Rupture. The SER noted that Boric Acid corroded a 1/2 inch diameter, 3/4 inch deep hole in the lower pressurizer head and could only be seen with the insulation removed. Boric acid corrosion causes damage and extends outages. Rates can be up to 1.65 inches per year. Small leaks can cause severe damage. Periodic inspections are needed to identify leaks. Sources of leaks need to be repaired.	Evaluation of boric acid damage was deferred to the evaluation of SER 13-87. Evaluation of inspection for boric acid was deferred to the evaluation of SER 13-87. Since maintenance will walk down and determine repairs, boric acid damage will be found and fixed.	The evaluation missed the point that the insulation needs to be removed to find the damage. There was no effort made to try to highlight this concern.
SER 35-87, Non-Isolable Reactor Coolant System Leak. Make sure that resistant material is used for valves. If a valve in the boric acid system fails, consider possible boric acid causes.	Spec M-452Q considers component specifications. Maintenance reports as found conditions to the plant engineers. They would recommend corrective actions.	The response was superficial and missed the point, but has little bearing on this issue.

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	The SER was distributed for information.	
SER 10-89, Reactor Coolant Pump Flange Leak from Loss of Bolt Preload. Bolts should be checked for preload.	Preload was checked due to other reasons earlier.	The focus and recommendations are on RCP stud tightness and not boric acid corrosion, which is referenced back to SOER 81-12 & SER 13-87.
SER 90-2, Pressurizer Heater Sleeve Cracking. Inspect Inconel 600 pressurizer heater sleeves for leakage.	The overall evaluation was deferred to the BWOG Material Committee "to monitor this issue to conclusion." The SER was distributed for information.	We were given the right answers, it's unknown if we recognized it and used it. This is a very interesting issue. NRC IN 90-10 was also issued on Inconel 600 Stress Corrosion Cracking and made much broader recommendations. The industry conducted studies on the problem. Based on the detail in related documentation, we seem to recognize the concern and we expended much effort in studying the problem. In memorandum NED 91-20038, we recognized that only a visual inspection can find a through wall crack. Boric acid is an indicator of a potential problem. It recommended that we inspect the CRDM tubes. Based on damage DB incurred in 6RFO, we understood the consequences of boric acid corrosion. See the BWOG safety evaluation, which is summarized in the "Other Documents" below.
SER 20-93, Intergranular Stress Corrosion Cracking in Control Rod Drive Mechanism Penetrations. The affected plants (in Europe) planned on inspected all head penetrations and installing new insulation to allow leak	Response deferred to BWOG. The conclusion said, "Based on the completed safety evaluation and the ongoing industry effort, no further action with respect	The response documentation includes a BWOG Project Authorization Request for the Material Committee. Task 5.4 is for developing top-of-head inspection tooling for CRDM nozzles. The task was planned for

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detection testing. The cracks are not significant to safety. Plants with similar head penetrations should review their testing and inspection programs.	to this SER is deemed necessary."	1996. There seems to be a gap of SEE-IN documents addressing boric acid corrosion and stress corrosion cracking between 1990 and 2000 - as if both issues fell off the nuclear radar screen. This was the only SEE-IN document found in that time frame. See the BWOG safety evaluation, which is summarized in the "Other Documents" below.
SER 4-01, Recent Events Involving Reactor Coolant System Leakage at Pressurized Water Reactors. Detailed reactor inspections are important to identify boric acid. Of particular concern are areas covered by insulation or otherwise inaccessible. Undetected or uncorrected RCS leakage can result in reactor coolant system pressure-retaining component degradation from corrosion and wastage. RCS leakage can result in extended outages or substantial increases in personnel radiation exposure. Small leaks often are not detected by installed leak detection systems or RCS inventory balance calculations, emphasizing the need for thorough visual and other nondestructive examinations. Oconee modified the service structure and cleaned the head to allow easier detection. Although still in study, VC Summer is doing Noble Gas sampling.	NG-EN-00324, Boric Acid Corrosion Control, provides the required actions to identify, evaluate, and resolve boric acid leakage and corrosion. Any identified leakage is evaluated to determine corrective actions. For leakage that is not repaired, monitoring is specified. The specific locations include Control Rod Drive Flanges. Inservice inspection program will perform leakage inspections beneath the reactor vessel head insulation.	The response gave the impression that the program was comprehensive. There was one OERC member who did feel the response was not adequate, but backed off. The response did not raise the issues that are coming to light now that we were unable to inspect the center part of the head and there was boric acid there and that we had decided not to fix or clean those areas. The response did not give any hints that there were weaknesses.

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SEN 6, Boric Acid Corrosion.	Evaluation deferred to SER 13-87.	
SEN 18, Reactor Vessel Head Corrosion	Evaluation deferred to SOER 81-12.	
SEN 190, Pressurizer Spray Valve Bonnet Nuts Dissolved by Boric Acid.	No evaluation found. Distributed for information.	A Davis-Besse event.
SEN 216, Leakage from Reactor Vessel Nozzle-to-Hot Leg Weld.	OERC determined that the document only contained preliminary information and no action can be taken at this time. Distributed for information.	Although the SEN only contained information and gave no recommendation on what could be done, it may have been more appropriate to have the system experts make that call.
SEN 220, Pressure Boundary Leakage at Palisades. Palisades had a through-wall crack in a CRDM housing.	Deferred to SEN 4-01.	
O&MR 348, Failure of a Limitorque Operator Stem Nut	DB is in compliance with recommendations.	This does not seem to provide any value to this issue.